

TECHNICAL FAX # 010103

To: All Fire Alarm Technicians
From: EST Technical Support
Date: January, 2001
Subject: EST3 Accumulative Data Network Capacitance

Introduction:

Accumulative data network capacitance refers to the total capacitance of all wire used in a data network. The accumulative capacitance of EST3 data networks must be within certain limits for stable network communications. The audio network is not affected by accumulative capacitance, due to the method of retransmitting data.

Audio Networks Are Not Affected:

The audio network retransmits data per character. Each character received is retransmitted by a UART, so bit times of a character are restored to original values at each node in the network. The data network retransmits data per bit. A communication driver immediately retransmits each bit received. This method of retransmitting data will restore the amplitude of a bit at each node, but any distortions in bit timing are passed through to the next node. Data network communication faults will occur at about 23% distortion of bit timing.

Fiber Links DO NOT Restore Bit Timing

A fiber link in a data network electrically isolates two nodes, but distortions in bit timing are NOT restored. Distortions in bit timing are passed through the fiber to the next node. The bit transition time of model 3-FIB fiber cards is fast enough to be neglected in calculations to determine the maximum wire length that can be used in the data network.

Data Network Specifications:

(Maximum between any 3 nodes):

Resistance: 90 ohms (Ω)
Capacitance: .3 microfarad (uf)
Distance: 5000 feet

(Entire Network):

Maximum Accumulative Capacitance		
Wire Size (AWG)	38.4K Baud (microfarads)	19.2K Baud (microfarads)
18	1.4	2.8
16	1.8	3.6
14	2.1	4.2

Maximum Accumulative Capacitance is the total capacitance of all installed copper wire used in an EST3 data network.



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Calculating Maximum Length of a Data Network:

The maximum length of a data network can be calculated by dividing the maximum accumulative capacitance by the highest capacitance rating of a selected cable. The maximum length of an EST3 data network desired to communicate at 38.4K baud with 18 AWG cable that is rated at 25pf per foot is 56,000 feet.

Max Length = Maximum Accumulative Capacitance / Capacitance per foot =

56,000 feet = 1.4uf / 25pf

(Note: 1pf * 1,000,000 = 1uf)

56,000 feet = 1.4 / 25 * 1,000,000

The maximum length of a data network will vary with the properties of the wire selected. Wire manufacturers typically provide specifications for wire resistance and capacitance. Resistance is generally specified in ohms per 1000 feet, and must be doubled for 1000 feet of a twisted-pair cable. Capacitance is specified in picofarads per foot (*pf/ft*). The capacitance between conductors of a twisted-pair is commonly referred to as '*conductor-conductor*' or '*mutual*' capacitance. Shielded cable will have an additional capacitive property for either conductor to shield. The capacitance of either conductor to shield is typically twice the value of mutual capacitance, and the highest value of capacitance must be used when calculating the maximum length of a data network. The overall length of data networks designed with twisted-pair cable is about twice as long as data networks designed with shielded cable due to the additional capacitance resulting from the shield. Data and audio networks in an EST3 system do not require the use of shielded cable, and networks designed with twisted-pair can be about twice as long.

Calculating Maximum Wire Capacitance per foot:

EST requires that data network wire be twisted-pair cable. The capacitive property of twisted-pair cable varies and the cost of cable generally increases as the capacitance per foot decreases. Following is a sample calculation for determining the maximum capacitance per foot that a cable can have for a given network length.

Max Cap pf/ft = Max Accumulated Capacitance / Total Network Distance

Max Accumulated Capacitance: Obtained from the table in this document.

Total Network Distance: Sum of the lengths of individual copper links.

The total copper distance of a network is 26,000 feet. Calculate the maximum capacitance per foot that can be used for 18 AWG twisted-pair cable at 38.4K baud.

53.8 pf/ft = 1.4uf * 1,000,000 / 26,000 feet

If you have any questions regarding this document please contact EST Technical Services in Sarasota, Florida at (800) 655-4497 or (941) 755-4811.

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